

PD-ABF-323

ISA 21007

**SWAZILAND
COMMERCIAL AGRICULTURAL PRODUCTION AND MARKETING
PROJECT**

CONTRACT NUMBER 645-0229-C-00-9019

**POTATO CONSULTANCY
FEBRUARY - MARCH 1992**

Submitted to :

**MINISTRY OF AGRICULTURE AND COOPERATIVES
MBABANE, SWAZILAND**

AND

**THE UNITED STATES AGENCY FOR
INTERNATIONAL DEVELOPMENT
SWAZILAND MISSION**

Prepared by :

**R.H. COLE
POTATO SPECIALIST**

Submitted by :

CHEMONICS INTERNATIONAL CONSULTING DIVISION

March 1992

TABLE OF CONTENTS

	<u>PAGE</u>
SECTION I: SUMMARY	1
SECTION II: OBJECTIVES OF POTATO SPECIALIST ASSIGNMENT	3
SECTION III: INTRODUCTORY REMARKS	4
A. Immediately Available Markets	4
B. A Swazi-Packed Product will be Fresh	4
SECTION IV: SWAZILAND'S POTATO PRODUCTION AND MARKETING RECOMMENDATIONS	5
SECTION V: A POTATO PRODUCTION/MARKETING CHECK-LIST	6
SECTION VI: POTATO PRODUCTION MANUAL	7
SECTION VII: "NEW" VARIETIES	11
SECTION VIII: POTATO SEED PURCHASES	12
SECTION IX: POTATO SEED PRODUCTION	13
APPENDIX A-1: POTATO PRODUCTION SECTION	
APPENDIX A-2: POTATO PRODUCTION AND MARKETING CHECK-LIST	
APPENDIX A-3: PRODUCING SEED POTATO TUBERS	
APPENDIX A-4: PRODUCTION DATES IN SWAZILAND	
APPENDIX A-5: INSECT AND DISEASE CONTROL RECOMMENDATIONS	
APPENDIX A-6: POTATO GROSS MARGIN BUDGET	
APPENDIX A-7: POTATO PRODUCTION MANUAL	

I. SUMMARY

A summary of my recommendations and observations, based on my assignment in Swaziland for the CAPM Project which took place between 24 February 1992 and March 20, 1992, is as follows :

- The CAPM Project is on target, in the right place at the right time. The development, nurturing, and success of the marketing firms which will be moving the products produced by small scale Swazi farmers, is essential.
- An excellent potato market presently exists in Swaziland.
- Small scale Swazi farmers are willing to commercially produce potatoes.
- Out-of-pocket potato production costs are higher than for most vegetable crops (E4000 - E5000). I do not think there are many possibilities of reducing these costs. Because of this, consistently high yields are essential. Substantial profits are possible with good yields, ie. over 20 tonnes per hectare.
- More technological production knowledge is needed by farmers for obtaining acceptable returns. The CAPM Staff is presently qualified to train potato growers and marketers in Swaziland. Their knowledge will be increased as they continue to work with the potato crop.
- We should ideally become convinced of the importance of using potatoes as the only Solanaceous crop in potato production rotations.
- Minimum uses of pesticides are recommended and an insect pest management approach suggested.
- A potato production/marketing check-list will be used in the project.

- Potato recommendations are to be used as a guide. They are not perfect and they can be modified to fit specific situations. Don't be surprised if farmers refuse to follow some of the recommendations and suggestions.
- Handle harvested potatoes like eggs. Also, never allow potatoes to be exposed to direct sunlight.
- Many selling tips were discussed. Label the pockets as "Swaziland Grown". Specialised markets may be developed by the marketing firms.
- New varieties from the International Potato Centre (CIP) should be tested in Swaziland in 1992.
- Certified potato seed will continue to be imported from the Republic of South Africa. A direct purchase arrangement with one or two seed growers in the RSA is recommended.
- A mass selection, seed tuber program is suggested. Private industry should be encouraged to produce seed tubers for certified Swazi seed growers. Government would be required to provide a regulatory function. New cultivars would enhance the likelihood of success of a seed program.

II. OBJECTIVES OF POTATO SPECIALIST ASSIGNMENT
FEBRUARY - MARCH 1992

The objectives of my one month assignment in Swaziland were as follows :

1. Assist the CAPM Project Team in the development of programmed commercial production of potatoes by small scale Swazi farmers.
2. Review Swaziland's potato production and marketing recommendations.
3. Conduct training of CAPM Project Field Assistants in potato production and marketing.
4. Suggest methods of securing several "new" cultivars for testing in Swaziland.
5. Recommend and outline potential programs of private/commercial production of potato planting materials.

III. INTRODUCTORY REMARKS

I arrived in Swaziland on Monday, February 24, following my two day flight from the USA.

I spent the first week of my stay in Swaziland talking with the CAPM Project leadership and staff, the leadership at USAID, the Swazi Agricultural Ministry and a few selected potato growers. Their thoughts of the major potato problems facing the success of the project were :

- the high potato production costs (including seed cost and availability);
- the need for potato advisors, marketers and growers to gain greater technical knowledge on production and marketing.

Because of this, emphasis of my work was placed on training, production and marketing techniques and seed costs and production.

In Swaziland potato production and marketing, the key to success is to be the best. What advantages do we have :

A. Immediately Available Markets

The marketing section informed me of the potential of potatoes as the major vegetable crop in the nation.

B. A Swazi-Packed Product will be Fresh

At least initially, only short term storage will be required, as the fresh dug potatoes will be moved rapidly to the consumer in Swaziland. Potato stores (storages) will be needed only when potatoes can not be sold at a price where farmers can make an acceptable profit.

IV. SWAZILAND'S POTATO PRODUCTION AND MARKETING RECOMMENDATIONS

The suggestions reviewed with the staff are presented in Appendix A-1. The original copy of the recommendations can be found in the Farmers Handbook (Chapter 8, p.64-69), the recommended chemicals in A-5 and the potato budget in A-6.

Very few changes were suggested. Only two varieties are presently available. More varieties or perhaps new varieties are needed. Soils should be characterised and chemically analysed as soon as this is possible. The importance of each crop in the rotation and the need to not use crops in the potato family was emphasised. "Best" planting dates, planting procedures, potential profits and seed holding and handling practices were discussed.

Disease and insect suggestions are based on the philosophy that cultural controls will be utilised whenever possible. The minimum use of pesticides is suggested. I encourage using even less fungicide if this appears feasible. Caution should be taken during cold-wet growth periods. An insect pest management approach is apparently feasible as project assistants will be visiting each grower at least once or twice a week.

The important steps involved in harvesting, handling and marketing were covered in detail. The schematic in Appendix A-2 was utilised in the discussion. Never allow the tubers to be exposed to direct sunlight at any time. Washed tubers are extremely sensitive to light from florescent bulbs. Potato tubers remain the property of the growers until they are paid for the product. Farmers should follow the movement of their product to the consumers. Cost cutting measures and the pit-falls of cost cutting were discussed.

V. A POTATO PRODUCTION/MARKETING CHECK-LIST

A potato production and marketing check-list was developed for use by the project Field Assistants (Appendix A-3). Remember the strength of the chain is only as strong as the weakest link. While you think it may not be needed, go over each production and marketing step.

It is recommended that a pest management program be developed and presented to farmers. This should include a list of pesticides with application rates and potential application dates. Farmers should also be instructed to record actual pesticide applications made to the crop. Storage reports should be maintained listing harvest date, amount harvested and date sold.

VI. POTATO PRODUCTION MANUAL

A draft of a potato production manual was completed on my 1988 assignment under the Cropping Systems Research and Extension Training Project and later adapted for the Farmer's Handbook (1991, MOAC). This draft was utilised in the training of CAPM Field Assistants (Appendix A-7). This provides many good ideas and the information may be very helpful. Now the field assistants must put all this together and utilise this information on the farm.

Emphasis in the training sessions was placed on the following :

- Select sandy to sandy loam soils when possible.
- Know the crops in the rotation.
- Try to eliminate other Solanaceous crops from the rotation. We need to determine how many crops should be planted between potato crops.
- Encourage the use of quality seed.
- Proper seed handling and seeding rates must be considered for successful production.
- Look at new varieties when they become available. Encourage on-farm testing by farmers.
- Request chemical soil analyses when they become available.
- Base fertilization on the results of the soil test as soon as this is feasible. Consider the use of farm manure and the use of legumes in the rotation. Residual soil fertility may be important in the production of a potato crop.
- Prepare potato lands properly. Attempt to keep a high organic matter level. Do not work the soils when they are wet.

- Choose your best planting date. This will be dependent upon the veld where you are located. Avoid high temperature soils. Remember potatoes prefer cool soil temperatures. Because of the high production costs, it should be assumed that irrigation will be provided.
- Go over all planting techniques with farmers. Study all procedures in detail. An acceptable stand is required for an acceptable yield. If furrow irrigation is used, do not allow the soil over the seed tuber to remain water logged for more than 24 hours. This would eliminate oxygen and the seed may rot. Avoid fertilizer burn. Fertilizer must not be in contact with the potato seedpiece. It is recommended that farmers plant on the side of the ridge and do not plant too deep.
- Rows should be filled with a complete ground cover about 8 weeks after planting. The desired row width may be different from farm to farm and from season to season. Make row width adjustments in future plantings.
- Spacings of seedpieces within the row will be dependent on the variety and the tuber size required in the market. If larger size is desired, increase the spacing within the row. Decrease spacing for smaller size tubers.
- Irrigate often. Do not over-supply water when tubers are forming. Soils must not be too wet or too dry.
- Study the hilling and weeding section in detail. Skilled labour is required to build an adequate hill for the potato plant.
- Follow the recommendations in the Farmer's Handbook when controlling potato pests.
- Guidelines for estimating harvest dates were discussed. This is required to assist in making marketing decisions. Technical skill and some good common sense is needed.

- Harvesting is the most important step in potato production. Planning and proper planting (seeding) were needed earlier. Then the crop had to be produced over a four or five month period. Now a bruise free crop must be lifted from the soil. Handle potatoes like an egg. Do not allow potatoes to be exposed to direct sunlight.
- High yields are normally needed for a substantial profit. Remember both yields and the sale price as well as production costs are a part of the profits formula. High yields sold at a reasonable price is beneficial to farmers and the consumers. We should be aiming at more than 20 tonnes per hectare.
- Holding potatoes on the farm in Swaziland, without controlled atmosphere storages, presents many challenges. It is not expected this will be a problem early in the project, as the supply will be quite low and potatoes should be rapidly moved to markets. These fresh potatoes should be preferred by local consumers.
- Initially marketing will not need to be very sophisticated. Saleable, cleaned potatoes will be placed in 10 kg pockets and moved to the markets. Pockets should be labeled as "Swaziland Grown Pockets". This will help identify them with the Swazi consumer. The marketing firms in the CAPM Project will have to establish the standards that will be acceptable. Only quality potatoes should be marketed in the "Swaziland Grown" pockets.
- Small tubers and large tubers of high quality can be marketed on special markets at acceptable or perhaps at higher than normal 10 kg pocket prices.

- What do we do with trash potatoes ? What will they be called?
What size packet should we use ? Some suggestions are as follows :
 - a) Pick-out could be labeled as "Pick-Outs". Only edible potatoes should be included in the pack.
 - b) A suggested pocket size is 5-10 kg. This could become the pocket size for pick out potatoes. Movement will be accelerated (because of the packet size and the reduced sale price) and will encourage sales to consumers looking for a bargain.
 - c) Under-sized tubers of high quality may be washed and packed in 1 or 2 kg packages and sold as a special gourmet item in certain markets.

VII. "NEW" VARIETIES

We would like to look at a few potentially new cultivars that might be useful in Swaziland. Imported germ plasm was last tested at the Malkerns Research Station in the early 80's. Materials from the International Potato Centre (CIP) in Peru is available for testing in 1992. Douglas Gama, Research Horticulturist, at the Malkerns Station has indicated he is willing to obtain these cultivars. This is an important first step. Mr Gama will obtain seed from:

CIP Regim III Office
P O Box 25171
Nairobi, Kenya

Additional cultivars could be obtained in small lots from the USDA at Beltsville, Maryland and/or Ag Canada at Fredericton, New Brunswick. Both of these sources have a major interest in evaluating germplasm. Commercial varieties are available from programs in Great Britain and the Netherlands. Established cultivars from seed programs in the States could also be made available upon request.

VIII. POTATO SEED PURCHASES

As of this date, there is no potato seed-tuber production in Swaziland. All seed is imported from the Republic of South Africa. Little is known about the exact origin of the seed or the seed growers in RSA. Essentially the seed is purchased through potato brokers or from an RSA Co-Operative brokerage. All seed is tagged as to variety and dated. It is obviously inspected by an RSA seed certification organisation. To the best of my knowledge, this seed has been satisfactory in quality. The seed appears to be sound when it arrives and burlap bags that are dry. Some of the tubers appear to have been desprouted. I would prefer to receive unsprouted seed, but sprouting must be initiated before seed tubers are planted. Diseases, that would have been transmitted through the seed, have not been observed in the foliage of growing plants.

If the current method of seed-tuber distribution is continued, an arrangement should be made with one or two seed growers in the RSA to supply a specific quantity of seed on specific dates. Partial advance payment (about 10%) will likely be required. This will guarantee the seed quality and the seed selling price. On average this method will slightly reduce seed costs in Swaziland. When seed is over supplied, seed costs will be greater when this method is utilized.

IX. POTATO SEED PRODUCTION

Should Swaziland have its own potato seed-tuber production? What type of program would be best suited for the nation? What will be the role of private industry and government?

We discussed in detail a meristematic type program. This might be looked at again two or three years from this date if potato production increases and seed problems are experienced. A meristematic seed program is not recommended at this time.

A mass selection seed-tuber proposal appears to have the best chance of success at this time. This would have even greater likelihood of success if a new cultivar was to be introduced in Swaziland. This might be possible within a two year period. This method would also be helpful in making seed of the present varieties available in the amounts desired by farmers.

It would be extremely desirable if a private seed industry could be encouraged to produce the improved seed tubers for the Swazi seed growers. A seed company could control the supply and guarantee the seed quality. The technology of seed production and skill of the growers would be maintained within the seed company. This seed would be multiplied by Swazi certified seed growers based upon the needs of the local farmers. Government would have to supply a regulatory function, inspect, certify, and provide seed tags for the certified seed.

The precise seed needs for each month during the year must be estimated. Seed for sale to farmers must be planted from seven to nine months prior to the date of this need for certified seed. Planting date will be dependant upon the cultivars and the season in which the seed is produced. Not all seed will receive a certificate of approval and be available to transport to farmers. Prior sales agreements with down payments are desirable.

How much seed is needed? Over the next two to four years it is suggested that Swazi seed should fill about one half the demand for potato seed-tubers. If the seed company starts with one hectare of spaced, heavily-rogued seed, and this is increased to 3 to 5 hectares on their property and heavily rogued again, the certified seed grower could expect to grow enough seed from 20 to 30 hectares. This would multiply to over 200 hectares in production fields by the small scale Swazi farmers.

The seed company must be business orientated and plan carefully. The roguer of the potato plants must be a trained plant scientist (likely a plant pathologist). Field workers will be trained by the skilled roguer - technologist. The business manager and the technologist must be long term employees.

Government certification people must be unbiased plant scientist that are supportive of the seed program. Extension workers will provide education and support the use of certified seed.

Will this program be successful ? Not necessarily. My thoughts are that the major problems would be leadership and finances. Potato tuber seed production is a high risk business. Farmers will expect Swazi grown seed to be superior to imported certified seed. Farmers must trust the Swazi seed growers. No seed costs have been projected, but I expect we can be competitive. If new cultivars are coming on stream, this would greatly enhance the likelihood of success of the program. Also good seed does not cost, it pays in profits to farmers.

In Appendix A-3, I have sketched the mass selection seed proposal. Potential seed company people should be contacted as soon as possible. I have gone over with CAPM staff some of the things to consider as well as the needs for a successful program. General production as well as projected seed production dates were discussed. Production estimates are also included.

APPENDIX A-1

POTATO PRODUCTION SECTION
(see Swaziland Farmers' Handbook, Chapter 8, p. 64-69)

REVIEW OF POTATO PRODUCTION RECOMMENDATION
FROM THE FARMERS' HANDBOOK FOR SWAZILAND
(PAGES 64-69)

I. VARIETIES

A. BP1

This is apparently the principal variety available, and quite often the only variety available. It is likely that it produced acceptable yield of large size tubers.

B. Up-To-Date

This variety does not seem to be generally available. Perhaps it is not preferred because the tuber size is smaller than BP1. It has been reported to be a high yield variety. Since it has earlier maturity than BP1, this may be the reason for the smaller tubers. Also there are more tubers (number per hill). This might be a good Lowveld winter grown variety. Keep in mind it is susceptible to late blight and blight is favoured in the cold winter months.

C. Cedara

I can not find any recent records of this variety being available or being grown.

D. Others

More varieties are needed and testing should be encouraged.

II. SOILS

Sandy to sandy loam soils should be encouraged. Fine textured soils should be discouraged. Moisture relationships and compaction are major problems in these "Heavy" soils.

Yield results in lower pH soils must be determined. The pH levels of 4.5 to 4.8 may provide problems. All soils should be uniformly characterised. There should be an attempt to do this in a meaningful way.

Soil analyses (chemically) should be encouraged as soon as this is possible. This is important to make profitable recommendations.

III. ROTATIONS

Be cautious about the other crops that are grown in the rotation. Maize or sorghum are apparently good crops to proceed potatoes. The organic matter levels in potato soils are very important. The higher the organic matter levels, the better the potato yield potential. Some legumes, such as vetch, will be looked at within the Experiment Station. This would improve soil structure and increase nitrogen levels.

IV. FERTILIZATION

Lower fertilizer rates should be studied at low pH levels. The availability of phosphorous is very important.

V. TIME OF PLANTING

Be very specific and select the "Best" planting dates. If you are not planting at the planting date for highest yield, estimate your sale price as well as your yield. Remember your profit is a function of both yield and sale price.

VI. HANDLING SEED

Be sure seed is sprouting before planting. Cold storage (4°C) should be available for seed growers for holding seed for short periods before it is delivered to farmers.

11

NOTE: Spacing, Planting, Hilling and Weeding, Irrigation were found to be covered adequately in the Farmers' Handbook.

VII. DISEASE AND INSECTS

[also see page 7 of "Disease and Insect Guide"]

A. Bacterial Wilt and Nematodes

Both of these can bring major problems and can be related. Cultural control is recommended. Control of nematodes by chemicals is not suggested. The nematode species are not known. Bacterial Wilt is caused by strains of PSEUDOMONAS SOLANACEARUM. Strains of tomato, tobacco and potato are major problems.

The pathogen is tuber borne. Latent infections (from symptomless plants and tubers) can occur when seed is grown at high elevations. Pathogens are not found in soils where the mean temperature is below 15°C. Pathogen growth is favoured by high soil temperatures and poor soil drainage. Decreased light intensity enhances Wilt susceptibility. Bacterial Wilt may attack 33 plant families, but Solanaceae is the most susceptible. A grass crop or fallowing soils (no weeds or crops) for a five or six month season is a possible control measure. Be sure to disinfect knives when cutting seed potatoes.

B. Blight (Early and Late Blight)

Dithane M45 - 5 weeks after planting (plants 15-20 cm high)

Dithane M45 - 7 weeks after planting

Dithane M45 - 9 weeks after planting

[use Ridomil MZ in 7th and 9th week if heavy foliage and late blight weather]

On 10,11,12 week spray Dithane M45.

More sprays may be required if more time is needed to bulk tubers or blights are severe.

C. Insecticide Sprays

Base these on a weekly pest management analysis, have available one or two broad spectrum insecticides. Have available at least one aphicide. Look for American Bollworm, aphids, CMR beetles, tuber moth, mites and others.

D. Common Scab

No control suggested.

E. Nematodes

Remove aldicarb from the recommendations.

F. Aphids

Control aphids and other insects with weekly sprays in seed production fields.

VIII. HARVESTING AND HANDLING

This is now the most important set of operations that the growers and the potato workers are going to do when producing a potato crop. Supervision is virtually impossible.

Do not allow harvested tubers to remain in direct sunlight at any time. Sun greening will quickly reduce the saleable value of the crop. Sunburned tubers will not be sold. These may result from improper hilling or sunlight coming through soil cracks in the hill.

Do not bruise the tubers. Handle potatoes like an egg. Be sure the potato skin is "set" and can not easily be rubbed with the thumb. Do not harvest when it is too hot or the soil is too wet or too dry.

Be cautious when washing or brushing tubers. Tubers may become bruised. Washed tubers are very susceptible to greening. Eliminate sunlight, florescent lighting - in fact all light if this is possible.

IX. MARKETING

Study the selling statement in the previous section and the post harvest handling in section of Chapter 9 (Farmers' Handbook), "Potatoes".

The exact procedures or sales should be considered in advance. The desires of the consumer(s) must be known in advance. If the consumer is pleased, everyone is happy.

Potato tubers remain the property of the grower until they are paid for their product. The farmers should follow the movement of their product to the consumer.

X. COST OF PRODUCTION

Every farmer should study the costs of producing and selling a potato crop. Total costs are close to E8,000. About 25% of this is seed costs, 25% fertilizer and pesticide costs and over 30% marketing costs, (see Budget, Appendix A-6).

Growers always look for ways to cut costs. Yields and product quality should not be sacrificed when attempting to minimize costs.

XI. FIELD PLANTING

Opening Statement - no change;

1. - no change;
2. - Irrigate between the ridges if soil is dry;
3. - no change;
4. - a seeding furrow should be made on the side of the ridge, about 6 to 10cm from the bottom of the ridge. Apply the basal fertiliser at the bottom of this seed furrow;
5. - no change;
6. - no change;
7. - no change;
8. - no change but add on to the present statements : Irrigation water should not cover the potato seed pieces. This can be avoided when you plant on the side of the ridges.

POTATO PRODUCTION AND MARKETING CHECK-LIST

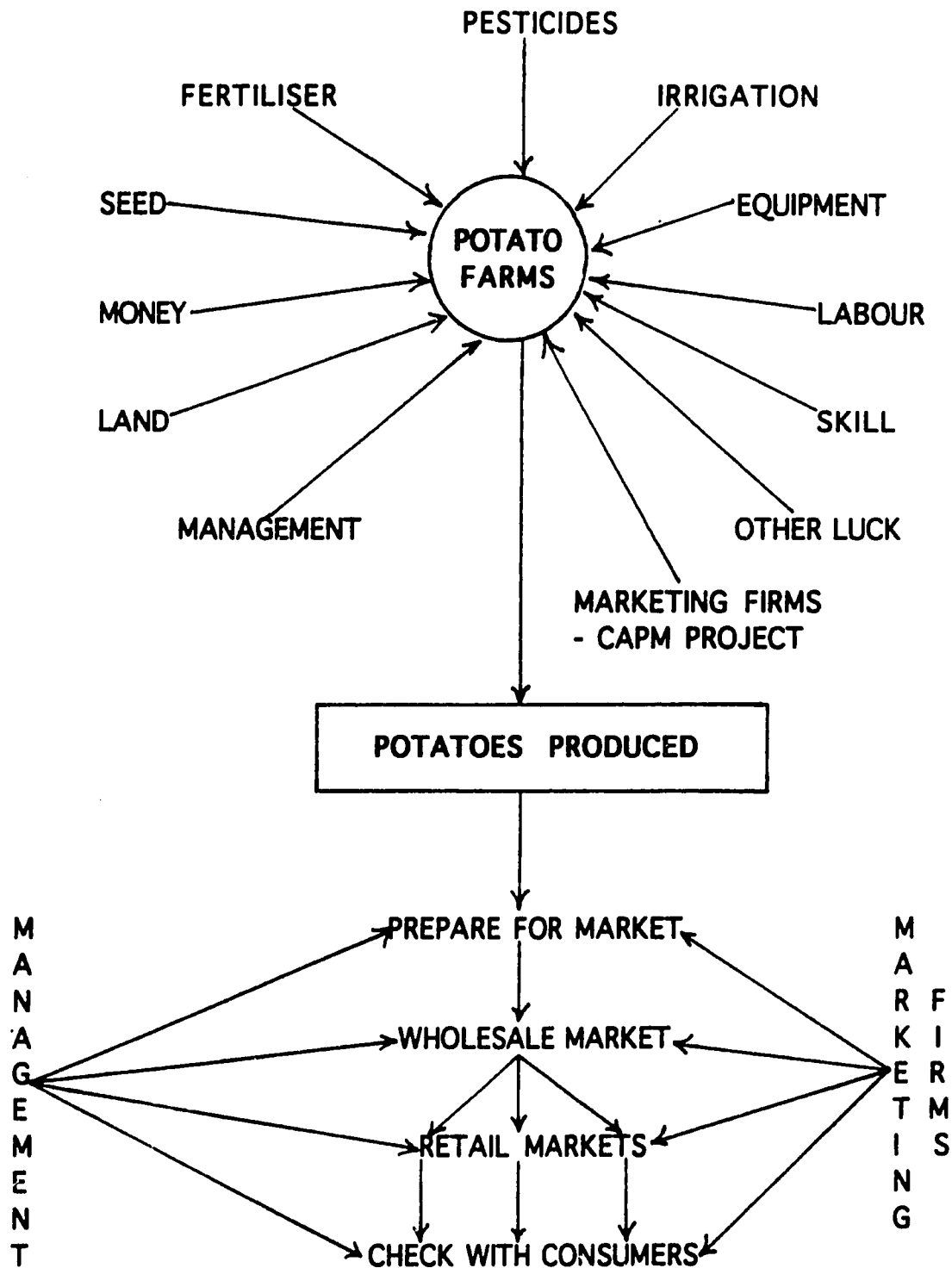
CAPM PROJECTPOTATO PRODUCTION AND MARKETING CHECK-LIST

1. How will the potatoes be marketed ?
2. Characterise the soils on the farm - were the soils analysed?
3. What crops were grown in the last two years ?
4. Has the seed been purchased ? What is the variety ? What is the seed condition ?
5. Has the fertilizer been purchased ? What fertilizer is available ?
6. Have you discussed the use and safe storage of farm chemicals with the grower ? What chemicals are involved ?
7. Go over in detail with the grower before planting :
 - Land preparation;
 - Seed handling;
 - Seed cutting;
 - Planting date;
 - Row width;
 - Seed spacing;
 - Exact planting techniques;
 - Soil moisture at planting;
 - Will seed be protected against fertilizer burn ?
8. What is the expected irrigation schedule ?
9. What is the hilling and weeding schedule ?
10. Did you go over the weekly crop and pest management report and determine how it will be left with the grower?

11. Go over in detail with the grower before harvesting :

- Expected date;
- Expected yield;
- Potential sun problems (emphasised);
- Soil moisture at harvest;
- Vine maturity discussed ?
- Bruising discussed ?
- Soil temperature discussed ?
- Tuber temperature discussed ?
- Holding techniques discussed ?
- Storage techniques discussed ?

12. Did you go over the weekly storage management report and determine where it will be left with the grower ?



PRODUCING SEED POTATO TUBERS

PRODUCING SEED POTATO TUBERSCONSIDER :

1. Who will produce the seed?
2. What additional technical knowledge is needed?
3. Who will rogue the fields?
4. Who will sell the seed?
5. Who will certify the seed?
6. Who will be fiscally responsible?

NEEDED :

1. Select seed growers.
2. Train seed growers:
 - A. Better management;
 - B. Improved production costs;
 - C. Best soils and production practices;
 - D. A higher level of pesticide usage;
 - E. More back-up support;
 - F. Greatest risk;
3. Roguers must be trained.
4. Special seed market channels established.
5. Seed certification coop. organized.
6. Responsibility clearly stated.

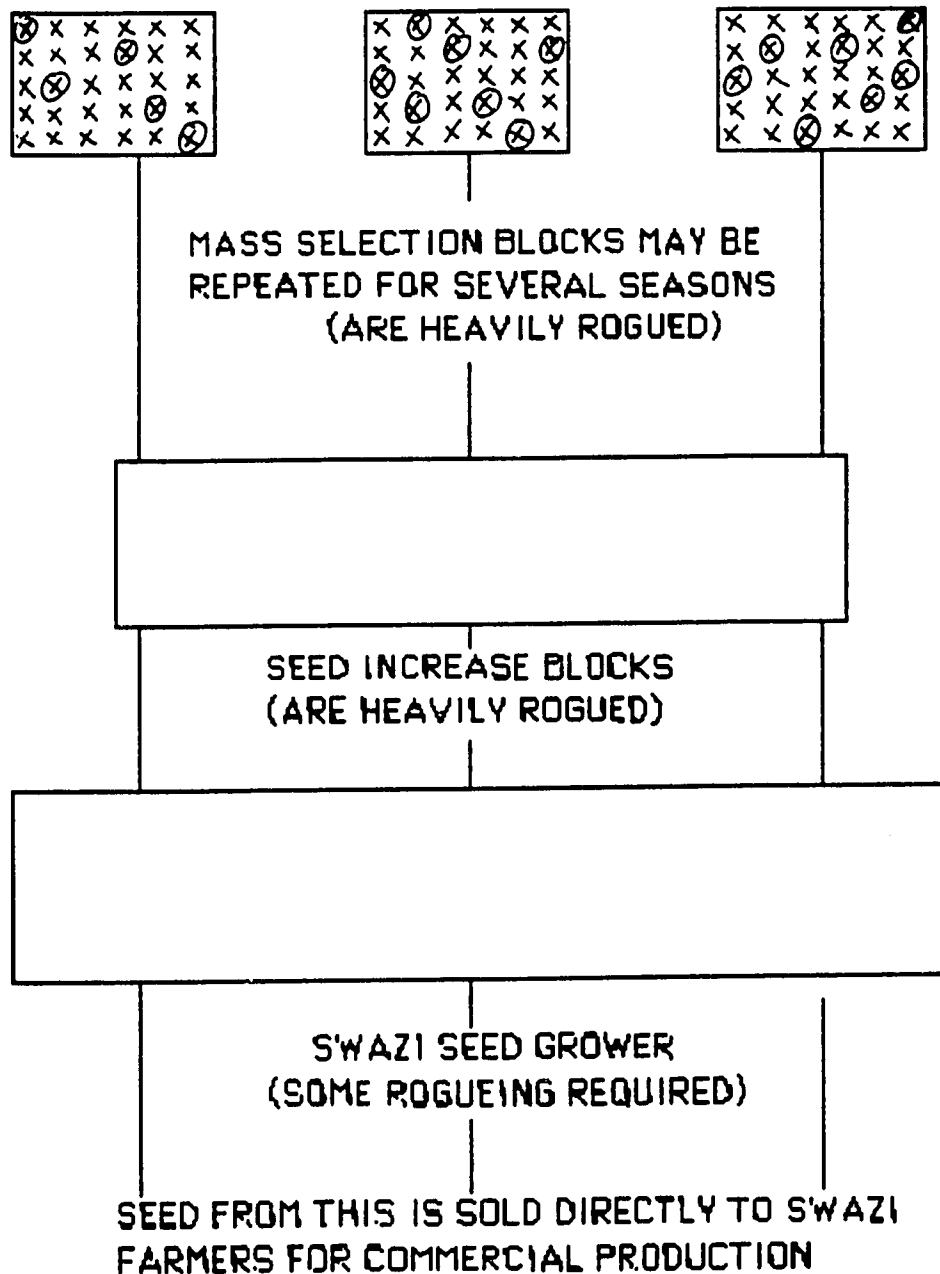
POTATO SEED PRODUCTION ESTIMATES

1 Hectare	Spaced - Rogued
↓	
3-5 Hectares	Heavy Rogued
↓	
20-30 Hectares	Some Rogueing
↓	
200 Hectares	Grown by Swazi Farmers

CAPM PROJECT

MASS SELECTION PROPOSAL

POTATO SEED - TUBER PRODUCTION



PRODUCTION DATES IN SWAZILAND

GENERAL POTATO PRODUCTION DATES IN SWAZILAND

<u>The Seasons</u> :	Spring	Sept, Oct, Nov
	Summer	Dec, Jan, Feb
	Fall	March, April, May
	Winter	June, July, Aug

Best Planting Dates :

Highveld: February, July, August, September, November, December

Middleveld: February, March, July, August

Lowveld: April, May, June

Growing Months :

Middleveld FEB, MAR, APR, MAY, JUNE

Lowveld APR, MAY, JUNE, JULY, AUG

Highveld SEPT, OCT, NOV, DEC, JAN

Sell :

May to Aug

Aug to Dec

Jan to May

SEED PRODUCTION DATES**Seed Produced in :****Seed Tubers Planted in :**

Highveld	SEP OCT NOV DEC Hold JAN FEB MAR	Lowveld
Middleveld	FEB MAR APR MAY Hold JUN JUL AUG	Highveld
Middleveld	JUN JUL AUG SEP OCT Hold NOV DEC JAN	Middleveld

Experimental

Lowveld	APR MAY JUN JUL Hold AUG SEP	Lowveld Summer Crop
----------------	------------------------------	-------------------------------

**INSECT AND DISEASE CONTROL RECOMMENDATIONS
(Farmers' Handbook)**

INSECT AND DISEASE CONTROL RECOMMENDATIONS
(Swaziland Farmers' Handbook)

Powdery mildew	benomyl 50 wp	0.5	0.5 kg	3
	sulphur 80% wp	2.0	2.0 kg	0
	sulphur 985 dp		20-30.0 kg	0
Apply at first sign of infection, repeat in 7-14 days if needed.				
Thrips	mercaptopthion 25 wp	2.0	2.0 kg	3
	mercaptopthion 50 ec	2.0	1.0 litres	3
Apply when pest is noticed, repeat after 10-14 days.				
Virus diseases	Grow resistant varieties when available and controlling aphids may help delay viruses which are transmitted by insects.			

POTATO

Disease/Insect	Chemical(s)	Tablespoons per 5 liters	Rate per ha	Days to withhold before harvesting
American bollworm	cypermethrin 20% ec	0.6	150.0 ml	3
Spray when larvae are less than 1 cm, repeat at 10-14 days intervals if necessary.				
Aphids (various species)	acephate 75% wsp	0.5	0.5 kg	14
	dimethoate 20 wp	1.5	1.5 kg	14
	dimethoate 40% ec	0.5	750.0 ml	14
	primidicarb 50% wp	0.5	0.5 kg	14
Apply when pest is present, repeat as necessary.				
CMR beetle	acephate 75% wp	0.5	0.5 kg	14
	mercaptopthion 25% wp	2.0	2.0 kg	7
	mercaptopthion 50% ec	1.0	1.2 litres	7
Apply when pest is noticed.				
Common scab	mancozeb 80% wp			
Dip seed tubers in a solution of 30 g in 10 liters before planting. Do not use on tubers for consumption.				
Early blight	chlorothalonil 75% wp	2.0	2.0 kg	3
	chlorothalonil 50% sc	1.0	2. litres	3
	mancozeb 80% wp	3.0	3.0 kg	3
	mancozeb 8% dp	-	10-25.0 kg	3
	Begin spraying before symptoms appear, especially in the wet season. Repeat spray at 7-14 days intervals and after heavy rains.			
Late blight	same as "early blight" plus metalaxyl/mancozeb (Ridomil MZ)	2.0	2.0 kg	5
Nematodes (various spp.)	aldicarb (gran)		50.0 kg	120
Apply and incorporate into the soil at planting. Warning: Aldicarb is very toxic and special care (including the wearing of protective gear) must be exercised when using it.				
Tuber moth	acephate 75% wsp	0.5	0.5 kg	14
Apply when pest is noticed, repeat after 10-14 days.				

TOMATO

Disease/Insect	Chemical(s)	Tablespoons per 5 liters	Rate per ha	Days to withhold before harvesting
American bollworm	acephate 75% wp	1.0	1.0 kg	3
	cypermethrin 20% ec	0.6	150.0 ml	3
Spray when larvae are less than 1 cm, repeat at 10-14 days intervals if necessary				

POTATO GROSS MARGIN BUDGET

POTATO GROSS MARGIN BUDGET- SUMMER

Grower:

No. ha:

INPUTS/ha	UNITS	AMOUNT	E/UNIT	VALUE (E)
Tractor hire (land prep. & plant)	hrs.	8.5	45.00	382.50
Seed tubers	kg	2000	0.94	1880.00
Fertiliser				
2-3-2(22)	kg	1270	0.75	952.50
LAN	kg	107	0.60	64.20
Labour	men-days	1.5		0.00
Planting (labour)	men-days	15		0.00
Hilling (labour)	men-days	18		0.00
Weed control				
1. Hand	men-days	28		0.00
2. Chemical/ hand				
Sencor 50W	kg			0.00
Disease and Insect Control				
Orthene 75wp - 5X	kg	2.5	76.50	191.25
Malathion 25wp - 3X	kg	6	9.35	56.10
Bravo 50sc - 12X	l	24	25.25	606.00
Ridomil MZ - 2X	kg	4	68.60	274.40
Labour	men-days	28		0.00
Irrigation (labour)	men-days	12.5		0.00
Harvesting (labour)	men-days	62		0.00
Total labour	men-days	165	5.00	825.00
SUBTOTAL				5231.95
Packaging	bag	1667	0.40	666.67
Transport	t km	100	0.10	250.00
Commission (12.5%)				1562.50
TOTALS				7711.12
RETURNS				
Yield/gross returns	tonne	25	500	12500.00
NET RETURNS/ha				4788.88

APPENDIX A-7

**POTATO PRODUCTION MANUAL
(from CSTRET Project, 1988)**

POTATO PRODUCTION MANUAL

Prepared by
Doyle Grenoble, Douglas Gamma, Dumile Sithole and Richard Cole

Consider First

1. Quality potato seed may be unavailable and/or the delivered seed price may be extremely expensive in some production seasons.
2. Foliar diseases are often difficult to control during the late spring and summer months.
3. The labor required for planting, hilling and weeding, and harvesting the crop is excessive on non-mechanized farms.
4. The costs of potato production and capital outlay is higher than most of the other vegetable and agronomic crops.
5. Potato sale prices are subject to wide variations, and are dependent upon the quality of your crop and the supply on the market at the time of harvest.
6. Never plant potatoes where nematodes are expected to be a major production problem.
7. Fine-textured soils, such as clay and silty-clay loams promote misshapen, variable size potato tubers.
8. Irrigation is required to protect your investment and grow a saleable potato crop in both the middle and lowveld in all seasons. If rainfed production is planned during the rainy season, supplemental irrigation should be available and used during high stress, drought periods.

Soils and Rotations.

Suitable soils for potatoes are sandy to sandy loams with a pH of 4.5-5.5. Clay soils tend to retard tuber formation and make lifting difficult. Soils with a high pH may encourage scab disease. Potatoes should not be planted following tomatoes, pepper, eggplant, groundnuts, sunflowers, tobacco, cowpeas and beans because of susceptibility to the same pest problems.

For best results, plant potatoes once every 3 or 4 years and rotate with maize and/or sorghum.

Seed Production

Seed fields should be rogued and periodically inspected by Plant Pathologists. A seed field must be grown using careful management to avoid spreading diseases. The major periods for planting seed potatoes are as follows:

1. Winter Crop - March planted with irrigation in the lowveld and middleveld.
2. Summer Crop - September planted with supplemental irrigation in the highveld and middleveld.

The March planted crop should be harvested for seed in July. Dormant, immature tubers need to be stored under warm, humid condition to promote sprouting. This seed is available for spring planting.

The September planted crop would be ready for harvest in January. When stored under warm, humid conditions, the dormancy is broken for planting in the fall. These must be considered as trial suggestions that should be tested by growers before being adopted as a recommended seed production practice.

Cold storages would allow other possibilities.

75

A November planted crop (harvested in April) is normally grown where there has the best likelihood of producing consistent quality seed. This seed might have to be held for up to a six-month period at a 4° C temperature and 95% relative humidity. Air movement through tubers is essential in cold stores. The costs of storage and compensation for the risks involved would be assessed to the seed price. Stored seed should be removed from cold storage about one month before the desired planting date and held at 15° C. to promote sprouting. This seed could be used for the highveld, summer season. Cold storages are not presently available in Swaziland.

Seed and Seed Rates

Pest problems can be transmitted on and in potato seed tubers. Some potato disease commonly found in tubers are caused by viruses, fungi and bacteria. Several organisms can be transported on potato tubers. Most of these pests are not observable when the tuber soundness is checked. To eliminate a major portion of these problems only clean, certified-quality, government inspected and tagged seed of a known variety and origin should be purchased and planted. With small seed pieces (35 to 45 mm dia.) about 60 bags (30 kg) per hectare or 3 bags per 500 m² are needed. Large seed (over 45 mm) requires 85 bags (30 kg) per hectare or 4 bags per 500 m².

Seed Handling

When seed is received, check to see if is tagged and appears to be sound (not wet or diseased). Observe the condition and length of the sprouts. Never plant seed that does not have sprouts beginning to form. If the sprouts are over 2 cm in length be careful not to desprout if it can be avoided. A 1 cm long green sprout would be ideal.

Seed may be stored inside a building for several days at temperatures of 15 to 20°. Open paper seed bags and daily observe the condition of the sprouts. If sprouting has not started, spread the tubers out in a thin layer on the floor where they are subject to air movement and high light (open shade). When dormancy is broken you will observe strong, short, stubby green sprouts. This seedpiece is ready to plant.

Seed cutting is required if the size is greater than 57 g. Cut seed can be planted immediately into warm, moist soils. This seed will normally vary in size from 43 to 57 g with each seedpiece having one or more sprouts or eyes.

Occasionally cut seed will have to be held after cutting before the date of planting. If this is necessary the storage conditions for the 3 or 4 days after cutting are very specific to promote wound healing (suberization) and allow the cut surfaces to heal. The requirements are 18° temperature, 90% relative humidity, and good ventilation. After this the tubers should be spread in a thin layer on a floor in high light but open shade to promote green sprouting (chitting) as previously described.

Recommended Varieties

- | | |
|-------------------|---|
| BP1 | Oval-shaped tubers of medium size with smooth tan to yellow skin and shallow eyes. Maturity is from 110 to 130 days. |
| Cedara | Mostly round tubers of medium size. Skin is slightly rough and tan with deep eyes. Maturity is from 120 to 140 days. |
| Up-to-date | Tubers are often irregular but tend to be oval and medium-sized with deep eyes. Flesh is yellow. Late blight susceptible. Matures in 100 to 130 days. |

Soil Testing

Base points should be established by soil analyses. Once these levels are known, changes in fertilizer and liming practices may be suggested. Very low pH soils of 4.5 to 4.8 may be too acid

for profitable potato production. The economics of and response to lime application are presently being investigated. Recommendations based on soil tests are expected to be more beneficial in future years.

Fertilization

Fertilizer requirements for potatoes can be best be determined from a soil test performed by the Soil Testing Unit of the Ministry of Agriculture and Cooperatives. In the absence of a soil test, the following can be used as a guide.

<u>Fertilizer rate in actual N-P-K in kg/ha</u>					
Basal			Topdressing		
N	P	K	N	P	K
70	105	70	30	0	0

A cold drink can (340 ml) is recommended for applying the fertilizer in a band along the row as described in the table below. Any one of the fertilizer types in the table can be used for basal application. A nitrogen material should be topdressed 3 to 4 weeks after emergence, during ridging.

Fertilizer type	Fertilizer amount kg/ha	Distance (M) to be covered by 1 can
Basal 2 - 3 - 2 (22)	1110	4.0
Basal 2 - 3 - 2 (30)	815	5.0
Basal 2 - 3 - 2 (38)	640	6.5
Topdress		
LAN (28)	107	32
Ammonium nitrate	87	40
Urea	65	48

Land Preparation

Prepare potato lands in advance of planting. Maintain organic matter in soils at as high a level as possible while keeping the planting area weed-free before planting. A deep, friable seedbed is desirable. Be cautious not to work soils while they are wet and keep soil compaction minimized when using tillage equipment.

Planting Dates

Plant on the dates that will maximize your profit potential. Yields are important but the market price at harvest is an important part of the profit formula. Consider the date you wish to harvest, some 100 to 150 days from planting. This varies with the variety and production season.

Time of Planting

REGION	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
Highveld	--	--	--	--	--	--	--	S	B	B	B	S
Middleveld	S	B	B	S	S	S	S	S	S	S	S	S
Lowveld	--	--	S	B	B	S	S	--	--	--	--	--

B - Best months

31

S - Suitable months

Potatoes grow best when days are cool but will not tolerate frosts. Satisfactory yields can be obtained in summer, except lowveld, if a good program of disease control is followed.

Based on a six-year average, market potato prices have peaked in July and December. Prices have been the lowest in the fall months of March to May. November through February have been months with the consistently high sale prices.

Planting Techniques

The sequence of the planting events are as follows:

1. Beds or deep furrows are formed with 90 cm centers.
2. Irrigate the furrow or time the planting following a rain.
3. Do not work in the soil while it is wet or muddy. About three to seven days after water is received, the soil will be moist and ready for planting. At this time the fertilizer is applied with a cold drink can onto the soil in a narrow band.
4. Cover the fertilizer band with 2 to 4 cm of soil. Planter fertilizer must not be in contact with potato seedpieces. This is extremely important.
5. Potato seedpieces are placed at the desired spacing above the fertilizer band in the furrow. Spacing may vary from 20 to 30 cm dependent upon the variety, sizing desired, and the experience of the farmer.
6. Seedpieces are then covered with 5 to 8 cm of soil. This might be increased to 10 cm if washing is expected with subsequent irrigations.
7. If the soil is moist around the seedpiece a waiting period is desirable before irrigating or receiving rainfall. If it is too wet around the seedpiece, decay is promoted. Dry soil around a fresh-cut seedpiece will remove moisture from the seed and adversely effect sprouting. Common sense, experience, and good luck are needed during this period. A quality, sound seedpiece will improve your chances of plant emergence.

Remember a satisfactory stand (at least 80%) is required for profitable yields. Stands below 60% are not normally satisfactory.

Spacing

ROWS - Furrows should be 0.9 M apart.

IN ROWS - Place the tubers 20 to 30 cm apart in the furrow.

Irrigation

Potatoes need frequent irrigations until the root system is fully developed. In addition, the first irrigation should be heavy. This heavy irrigation will fill the expected root zone of the crop. This will help the roots to develop to their maximum potential. Irrigations can be done less frequently after the crop is established. Care must be taken not to allow irrigation water to uncover the seeds.

Potato roots do not do a good job of taking up water. For this reason, potatoes should be irrigated often, especially when the tubers are forming. If the soil is allowed to become too dry before irrigating then small, poorly-shaped tubers will be formed.

Further information on the irrigation of vegetable crops is available in the irrigation Recommendation Guides produced by the Ministry of Agriculture and Cooperatives.

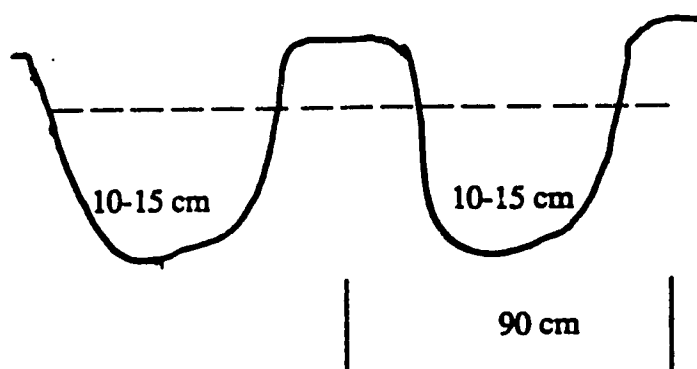
Hilling and Weeding

It is generally accepted that hilling is a desirable practice in potato culture. Weeding is accomplished as the hills are being built. Hilling should be started when the plants are 10 cm in height. Never cover more than one-half of the plant.

The process is usually repeated every week or every other week until the desired hill has been built.

Hilling reduces the risk of sunburned and green tubers. Tuber moth problems are also reduced. A steep, deep but level hill (on top) will help eliminate excessive moisture problems when irrigation or heavy rainfall occurs after tubers are formed. Finally, it is easier to harvest from hills by hand or with harvesting machines.

By the time the plants are 20 to 30 cm high, the plants should be fully ridged or hilled to a depth of 10 to 15 cm. See illustration.



Pest Control

Pest	Description	Control in 5 L of Water
Cutworm	Dirty looking caterpillar found coiled in soil where it hides during the day. It cuts plants just above soil surface.	Bait before emergence using ready-made cutworm bait.
Late Blight	Expect this during periods of high rainfall, 90% relative humidity in the foliage, night temperatures of 5 to 20° and day temperatures of 20 to 27° degrees. Starting with the lower leaves the disease appears as pale green spots which later-brown and spread to other leaves. A white mould may be seen on lower surfaces of leaves. Stem infection appears as brown streaks as disease spreads. Tuber damage blotches on the skin, and eventually the whole tuber is destroyed by rot caused by secondary infection.	Routine sprays at 7 to 14 day intervals with either Dithane M45(10 g) or Bravo. 00 (12 ml) are used. These are protective chemicals. Ridomil MZ (18 g) may be used under conditions very conducive to blight. Two applications are recommended when the environment appears as grey, slightly sunken favors blight or when late blight is found.
Early Blight	Dark brown circular lesions with characteristic concentric circles on the leaves.	Same protective chemicals as for Late Blight but begin applications soon after emergence. Spray every 7

days. Ridomil MZ is not recommended for early blight.

Bacterial Wilt	Characterized by sudden wilting with no leaf yellowing. Stem centers become water-soaked, turn brown & may become hollow. Cut stem exudes milky substance.	Certified seed; rotation and good soil drainage; do not plant tomato, pepper, eggfruit or tobacco where soil is infected.
Scab	Tubers become pitted.	Certified seed
Aphids	Small light or dark green insects found living in colonies under the leaves.	Rogor (Dimethoate) 40 EC (7 ml) or Pirimor 50 WP (Primicarb) - 2 g or Orthene 75 SP (Acephate) - 4 g.
Potato Tuber Mot H	Small cream larvae found feeding inside the leaf and causing blistering. On stems they cause withering and death of young shoots. They also tunnel inside tubers.	Cultural measures such as ridging helps in controlling the worms. Orthene 75 SP-4 g or Kayazinon 50 WP (Diazinon) - 6 g.
Leaf-eating	CMR beetles-big beetle with yellow and black bands on wing coverings.	Malathion 25 WP - 20 g; 50 WP - 10 ml or Orthene 75 SP (Acephate) - 4 g.

Harvest Dates

The major factors affecting the harvest dates are the potato variety, the elevation of the producing location, production season and the planting date. Some general guidelines for a 120-day variety are as follows:

Planting Date	Harvest Date	Comments
January	May	Normal maturity
February	June	Normal maturity
March	July	Delayed 1 or 2 weeks
April	August	Delayed 2 to 3 weeks
May	September	Delayed 2 to 3 weeks
June	October	Delayed 2 to 3 weeks
July	November	Delayed 1 or 2 weeks
August	December	Normal maturity
September	January	Normal maturity
October	February	1 to 3 weeks early
November	March	1 to 3 weeks early
December	April	1 to 3 weeks early

Harvesting Techniques

Good seed must be available before potato production can be considered. Then a vigorous plant must emerge and receive adequate management for normal growth. Finally, we have arrived

40

at the most important step in producing a saleable product. Farmers must now harvest a bruise-free potato crop.

Moist, sandy loam soils are preferred. Avoid wet soils because of soil compaction and muddy tubers that give cleaning problems. Dry soils are usually cloddy and increase tuber bruises.

If the plant has green foliage, you are likely to have immature tubers. Skinning is expected when harvested. This type of harvest is common for some of the from-the-field processing potatoes. Chip and fry color is normally excellent for many varieties at this time, because starches have not had the opportunity to convert to reducing sugars that promote a dark color fry. If this crop is to be used for tablestock, and the tuber temperature is above 20° C, it is desirable to cool tubers to about 15° C for a three to four-day period before shipment and/or sale.

Tablestock potatoes are more likely to be matured in the farmers field. These will not be harvested until the plants are completely dead and the skin is "set" or cannot be easily rubbed with the thumb. Tubers should be harvested in temperatures between 10 and 30° C. Do not harvest if it is too hot or too cold.

Lift the tubers with a machine to remove the druggery from the harvesting operation. Take every step possible not to bruise the tuber. Handle it like an egg. Bruising is increased when the tuber temperature is too hot or too cool.

Do not allow harvested tubers to remain in direct sunlight at any time. Sun greening will quickly reduce the saleable value of your crop. During hot weather move tubers to a cool storage. In cool weather, hold tubers at 15° C for two weeks and then move to a cooler storage area, if possible.

Marketing

The saleable product must be sized, dry, dirt-free and free from diseased, misshapen and mechanically damaged tubers. While sizing is not controlled by government regulation, market tuber diameters commonly found in Swaziland are as follows:

- 4 to 9 cm diameter some packs,
- 4 to 6 cm diameter commonly found, and
- 6 to 9 cm diameter some packs.

Special sales would be required with tubers smaller than 4 cm diameter (43 g) and tubers over 9 cm diameter. Many of the marketing problems can be controlled by good potato production and harvest management practices. Tubers will normally require brushing or washing, or both when sold in city markets. Washed tubers should be packed in paper to reduce greening when sold at farmers markets or on super market shelves. Consumer preference should always be considered when growing, packaging and selling the potato crop.

Holding Potatoes

Following the two-week healing period after harvests, potato tubers are best stored at 4° C and 95 % relative humidity with air movement through the potato pile. Special storages are required to meet these conditions. Use good judgement when piling potatoes and do not pile too high.

For a two-month period, a temperature of 10° C would be acceptable, and 15° C is satisfactory for about a month. Temperatures below 0° will freeze the flesh of the potato tuber, and make it unusable.

In cool soils, potato storage in the hill may be satisfactory for short periods. Storage in wet soils will normally create significant rot, harvesting and cleaning problems.

Consuming Potatoes

When you are a potato grower, it is in your best interest to encourage potato consumption. Be proud of your product. Inform the public about what is required to produce a profitable crop. Pass on your favorite cooking methods. Have a slogan such as — "Potatoes are something good, that's good for you."